

**REMARKS/ARGUMENTS**

Claims 1-12 and 20-26 have been previously withdrawn. New claims 27-32 have been added by the Amendment. Claims 13-19 and 27-32 are currently pending in the application, are rejected, and are at issue.

**§ 102 Claim Rejections - U.S. Patent No. 6,562,633**

Claims 13-19 stand rejected under § 102(b) as anticipated by U.S. Patent No. 6,562,633 to Misewich et al. ("Misewich"). Applicants respectfully traverse the Examiner's rejections for at least the following reasons.

First, Applicants dispute the Examiner's categorization of Misewich as a § 102(b) reference. Misewich issued to patent on May 13, 2003, and was published under Publication No. 2002/0118369 on August 29, 2002. The present application was filed on December 3, 2001, claiming the benefit of provisional patent application Serial No. 60/275,969 filed on March 15, 2001. Thus, Misewich is clearly not a § 102(b) reference. Assuming, *arguendo*, that Misewich could be considered a § 102(e) reference, Applicants respond to the Examiner's rejections as follows.

Independent claim 13 recites a magnetic recording disc for magnetic recording, which includes "*a disc substrate having a locking pattern formed therein; and nanoparticles completely filling the locking pattern and exhibiting short-range order characteristics.*" Similarly, independent claim 27 recites a data storage medium for magnetic recording, which includes "*a substrate having a locking pattern formed therein; and nanoparticles completely filling the locking pattern and exhibiting short-range order characteristics.*" Misewich neither teaches nor suggests these limitations.

Misewich is not directed toward magnetic recording discs or data storage media.

Misewich teaches the use of patterning nanostructures, or nanoparticles, on a ferroelectric thin film using an atomic force microscope to define nano-circuit patterns. The nano-circuit patterns are formed on the ferroelectric film by inducing a remnant polarization at a domain of the ferroelectric film using the conductive nano tip of the atomic force microscope (col. 3, lns. 25-30). The nanoparticles of Misewich are coated with an organic species. The organic coating is polarized and adheres the nanoparticles to the polarized fields of the ferroelectric film via an electrostatic attraction. Accordingly, there is no self-assembly of nanoparticles such that the nanoparticles exhibit short-range order characteristics, as recited in independent claims 13 and 27.

While Applicants note that Misewich does include the phrase "to selectively self-assemble nanoparticles" at col. 1, lns. 46-47 and 64, this phrase in Misewich does not refer to the short-range order characteristics of the nanoparticles, as recited in independent claims 13 and 27. Misewich teaches modulating the nanoparticle/substrate interaction using, for example, an atomic force microscope, to selectively assemble the nanoparticles. This is not the self-assembly technique taught by the present invention and recited in independent claims 13 and 27. The self-assembly technique recited in independent claims 13 and 27 relies on the short-range order characteristics of the nanoparticles. Conversely, the assembly technique taught in Misewich relies on the adsorption of the organic coating on the nanoparticles to the polarized portions of the ferroelectric film to adhere the nanoparticles to select regions on the substrate. As stated in Misewich:

[T]he invention provides a method of producing a structure by pre-patterning a surface with nanoscale resolution to assemble structures of nanoparticles, molecules, or localized products of molecular decomposition. Stable ferroelectric

domains on the nanometer scale can be prepared in various states of remnant polarization by use of an atomic force microscope (AFM) using a properly biased metal tip. This allows persistent patterning of the surface potential with nanoscale resolution which is then used to draw a locus where nanoparticles or molecules are induced to assemble by the strong localized electrostatic interaction when deposited from a solution with non-polar solvent, or where selective molecular decomposition in a CVD process occurs. The proximity of two oppositely polarized surface regions and the magnitude of the polarization can be adjusted to control the relative field strengths at the surface and thereby control the deposition of neutral but polarizable nanoparticles or molecules. This method is useful for fabricating circuits in the nanometer scale. (*emphasis added*).

Misewich, col. 2, ln. 61 - col. 3, ln. 13. This adsorption technique via the electrostatic forces between the organic coating on the nanoparticles and the ferroelectric film is not the self-assembly technique taught and claimed by the present invention.

Independent claims 13 and 27 require that the nanoparticles completely fill the locking pattern formed in the substrate and exhibit short-range order characteristics. The short-range order characteristics exhibited by the nanoparticles are such that the nanoparticles will form an ordered structure across a short length scale. The locking pattern is formed in the substrate according to the self-assembly coherence length scale of the nanoparticles and, accordingly, the nanoparticles self-assemble therein forming self organized magnetic rays and planarizing the substrate surface. The self-assembly of the nanoparticles that is due to their short-range order characteristics is influenced by the nature of the interactions exhibited among the nanoparticles, such as, but not limited to, ionic bonds, hydrogen bonds and van der Waals interactions. This self-assembly of nanoparticles due to their short-range order characteristics, as recited in independent claims 13 and 27, is distinctly different from the electrostatic interaction between the nanoparticles and the substrate as taught by Misewich for assembling the nanoparticles on the substrate. Accordingly, Misewich does not teach or suggest the limitations recited in independent claims 13 and 27.

Additionally, Misewich is not concerned with the magnetic properties of the resulting structure but, rather, is concerned with the formation of interconnections for electronic circuits. As shown in Figs. 3A-C, the formation of nanoparticles on the substrate is for providing an electrical connection between two metal electrodes 20 and 30. As described in Misewich, the ferroelectric film 12 is scanned by an atomic force microscope, the conductive tip of which is biased with respect to the substrate. Scanning with the atomic force microscope will develop a desired ferroelectric remnant polarization trace 25 where a wire will be formed, and the surrounding areas are left unpolarized. The patterned ferroelectric 25 enhances, or induces, the adsorption of the nanoparticles via its strong electrostatic interaction with the organic coating on the nanoparticles. The nanoparticles are coated with an organic coating which becomes polarized and adheres to the polarized traces in the substrate. In the example shown in Fig. 3, the nanoparticles adhere in the patterned ferroelectric trace 25, and thus assemble at 35 (see Fig. 3C) to form a wire connecting the electrodes 20 and 30. The nanoparticles are adhered to, i.e., adsorbed by, the substrate via the electrostatic interaction between the polarized ferroelectric coating and the organic coating on the nanoparticles. While the nanoparticles of Misewich do assemble in select areas of the substrate, their assembly is in no way considered a "self-assembly" such that the nanoparticles exhibit short-range order characteristics, as recited in independent claims 13 and 27. The electrostatic forces between the polarized ferroelectric film and the organic coating on the nanoparticles will not permit such self-assembly of nanoparticles.

Moreover, the locking pattern formed in the disc substrate, as recited in independent claims 13 and 27, is not the same substrate pattern formed by Misewich. Misewich deposits a ferroelectric film on a substrate, and patterns the ferroelectric film using an atomic force microscope to change the polarization of certain areas of the ferroelectric film to form a pattern.

Conversely, the locking pattern of the present invention includes a patterned region of etched pits formed in the disc substrate, with the pits sized such that their lengths are compatible with the self-assembly coherence length scale of the nanoparticles such that the nanoparticles self-assemble therein. With respect to dependent claim 17 (and also new claim 31), for example, the Examiner cites col. 3, lns. 62-64 of Misewich as teaching a pit depth formed in the substrate. However, this portion of Misewich has nothing to do with a pit depth, but rather teaches providing two metal electrodes in the substrate having a one micron separation on the ferroelectric film.

Accordingly, for at least the above-identified reasons, Applicants submit that independent claims 13 and 27 are allowable over Misewich.

Claims 14-19 and 28-32 depend cognately from independent claims 13 and 27, respectively, recite further structural detail further delineating over the prior art, and are also believed allowable.

### **Conclusion**

In summary, Misewich does not teach or suggest the self-assembly of nanoparticles in a locking pattern, with the nanoparticles completely filling the locking pattern and self-assembling in the locking patterns such that the nanoparticles exhibit short-range order characteristics.

Thus, for at least the above-identified reasons, Applicants submit that claims 13-19 and 27-32 are allowable over the prior art of record. Reconsideration of pending claims 13-19 and 27-32, allowance and passage to issue are respectfully requested.

It is believed that this Amendment requires no fee. However, if a fee is required for any reason, the Commissioner is hereby authorized to charge Deposit Account No. 02-4553 the necessary amount.

Respectfully submitted,



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